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(54) **METHOD OF PRODUCING AN INSULATED EXHAUST DEVICE**

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This patent is subject to a terminal disclaimer.

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F01N 13/14 (2010.01)

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CPC ***F01N 13/14*** (2013.01); ***F01N 13/148*** (2013.01); ***F01N 13/18*** (2013.01); *F01N 2310/02* (2013.01); *Y10T 29/49826* (2015.01)

(58) **Field of Classification Search**
CPC F01N 13/18; F01N 13/14; F01N 13/141; F01N 13/148; F01N 13/102; Y10T 29/49345; Y10T 29/49398
USPC 29/890.08, 890
See application file for complete search history.

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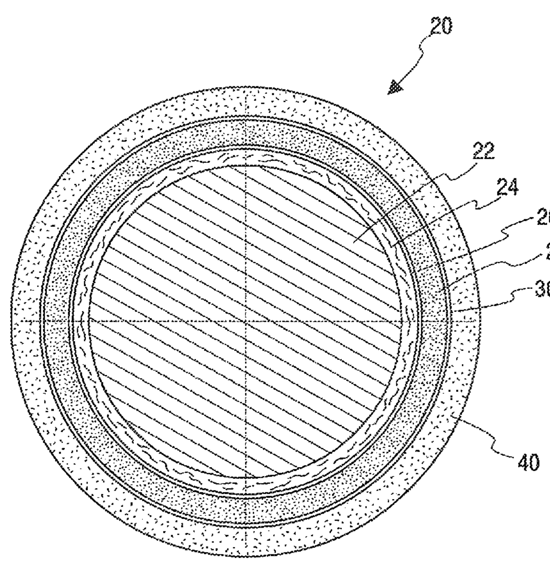
(57) **ABSTRACT**

A method is provided for producing an exhaust gas aftertreatment or acoustic device (**20**) having a maximum operating temperature T_{MAX}. The method includes the steps of providing a blanket (**40**) of silica fiber or alumina insulation material having a weight percentage of SiO_2 or Al_2O_3 of greater than 65%; calcining the insulating material by heating the blanket (**40**) so that all of silica fiber insulation material is raised to a temperature T greater than T_{MAX}; and securing the blanket (**40**) on the device (**20**) after the calcining step. The blanket is encapsulated in a covering prior to the securing step, and before or after the calcining step, with the covering between the blanket and the device being a selected one of foil, wire mesh, or siliconized fiber glass.

8 Claims, 1 Drawing Sheet



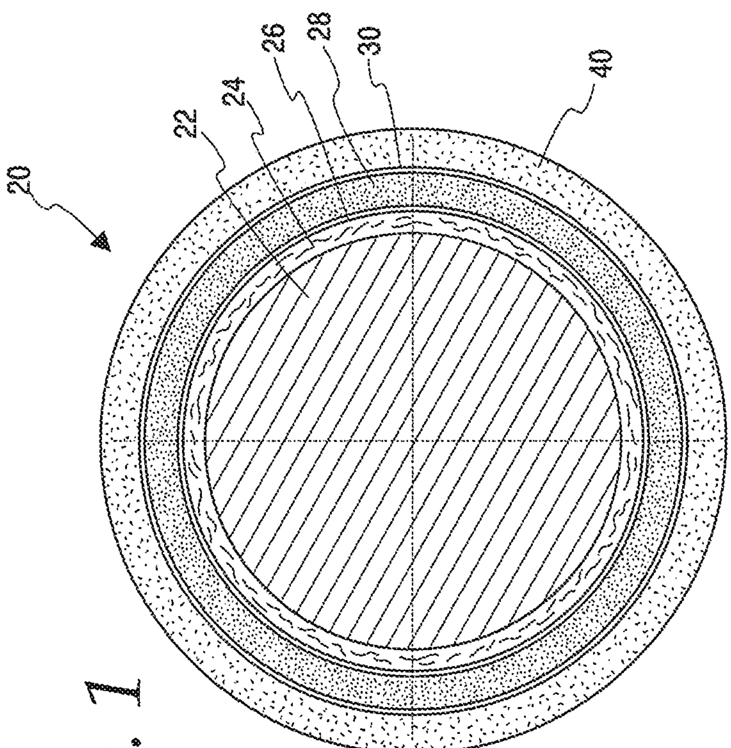


Fig. 1

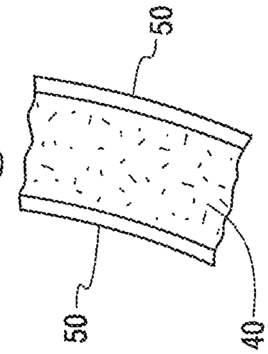


Fig. 2

METHOD OF PRODUCING AN INSULATED EXHAUST DEVICE

CROSS-REFERENCE TO RELATED APPLICATIONS

Not applicable.

FEDERALLY SPONSORED RESEARCH OR DEVELOPMENT

Not Applicable.

MICROFICHE/COPYRIGHT REFERENCE

Not Applicable.

FIELD OF THE INVENTION

This invention relates to exhaust gas aftertreatment and/or acoustic systems and the devices used therein that utilize external insulation blankets.

BACKGROUND OF THE INVENTION

Heat insulating batts and blankets are utilized in exhaust gas systems in order to provide heat insulation for acoustic and aftertreatment devices of the system to control the heat exchange to and from the devices. It is known, for example, to place heat insulating blankets between adjacent wall surfaces of such devices with the material of the heat insulation blanket being compressed to provide a desired installed density for the material to help maintain the heat insulating blanket in its mounted position via frictional forces between the blanket and the adjacent wall surfaces. Such a structure is shown in U.S. Ser. No. 12/696,347, filed Jan. 29, 2010 by Keith Olivier et al., entitled "Method of Producing an Insulated Exhaust Device", the disclosure of which is hereby incorporated by reference.

It is also known to provide heat insulation blankets around the exterior of such exhaust gas system devices. However, such blankets have been found to encounter a variety of failure modes, including damage and cracking when removing and replacing insulation, damage due to exposure to vibration, damage due to loose or otherwise inappropriate fit due to thermal set, loss of insulation properties due to loose or otherwise inappropriate fit, and/or loss of insulation material.

The present invention is directed to overcoming one or more of the problems set forth above.

SUMMARY OF THE INVENTION

In one aspect of the present invention, a method of providing external insulation for an exhaust gas aftertreatment or acoustic device having a maximum operating temperature T_{MAX} is provided, where the method includes (a) providing a blanket of silica fiber insulation material having a weight percentage of SiO_2 of greater than 65%, (b) calcining the blanket by heating all of silica fiber insulation material to a temperature T between T_{MAX}, wherein T is less than the melting temperature of the silica fibers of the blanket; and (c) securing the blanket around the device after the calcining step.

In one form of this aspect of the invention, T is at least $1.05\times T_{MAX}$.

In another form of this aspect of the invention, the method further includes encapsulating the blanket in a covering after

the calcining step and prior to the securing step whereby the blanket is batting in the covering, wherein the covering between the blanket and the device is a selected one of foil, wire mesh, or high temperature textile. In a further form, the high temperature textile is a selected one of siliconized fiber glass or straight woven glass fiber. In another form, the blanket is encapsulated in a covering before the calcining step.

In yet another form of this aspect of the present invention, during the calcining step the blanket is an uncompressed state.

In another form of this aspect of the present invention, T_{MAX} is within the range of 300° C. to 1100° C.

In still another form, the securing step comprises installing the blanket so that the blanket encircles a core of the device through which the exhaust gas passes.

In yet another form, the silica fiber insulation material has a weight percentage of SiO_2 of greater than 95%.

In another aspect of the present invention, a method of producing an exhaust gas aftertreatment or acoustic device having a maximum operating temperature T_{MAX} is provided, where the method includes (a) providing a blanket of alumina insulation material having a weight percentage of Al_2O_3 of greater than 65%, (b) calcining the blanket by heating the alumina to a temperature T greater than T_{MAX}, wherein T is less than the melting temperature of the alumina insulation material of the blanket, and (c) securing the blanket around the device after the calcining step.

In one form of this aspect of the invention, the method further includes encapsulating the blanket in a covering after the calcining step and prior to the securing step whereby the blanket is batting in the covering, wherein the covering between the blanket and the device is a selected one of foil, wire mesh, or high temperature textile. In a further form, the high temperature textile is a selected one of siliconized fiber glass or straight woven glass fiber. In another form, the blanket is encapsulated in a covering before the calcining step.

In still another form, the alumina insulation material has a weight percentage of Al_2O_3 of greater than 95%.

Other objects, features, and advantages of the invention will become apparent from a review of the entire specification, including the appended claims and drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a section view of an exhaust system component employing the invention; and

FIG. **2** is a section view of a portion of the external blanket of the present invention encapsulated in a covering.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

The present invention may be used, for example, in an exhaust gas system such as a diesel exhaust gas aftertreatment system to treat the exhaust from a diesel combustion process (e.g., a diesel compression engine). The exhaust will typically contain oxides of nitrogen (NO_x) such as nitric oxide (NO) and nitrogen dioxide (NO_2) among others, particulate matter (PM), hydrocarbons, carbon monoxide (CO), and other combustion by-products. The system may include one or more exhaust gas acoustic and/or aftertreatment devices or components. Examples of such devices include catalytic converters, diesel oxidation catalysts, diesel particulate filters, gas particulate filters, lean NO_x traps, selective catalytic reduction monoliths, burners, manifolds, connecting pipes, mufflers, resonators, tail pipes, emission control system enclosure boxes, insulation rings, insulated end cones, insulated end caps, insulated inlet pipes, and insulated outlet pipes, all of any cross-sectional geometry, many of which are known.

As those skilled in the art will appreciate, some of the foregoing devices may be strictly metallic components with a central core through which the exhaust flows, and other of the devices may include a core in the form of a ceramic monolithic structure and/or a woven metal structure through which the exhaust flows. These devices are conventionally used in motor vehicles (diesel or gasoline), construction equipment, locomotive engine applications (diesel or gasoline), marine engine applications (diesel or gasoline), small internal combustion engines (diesel or gasoline), and stationary power generation (diesel or gasoline).

FIG. **1** shows one example of such a device for use in a system such as described above, in the form of a catalytic unit **20** such as shown in Olivier et al. U.S. Ser. No. 12/696,347, the disclosure of which was heretofore incorporated by reference.

The catalytic unit **20** has a catalytic core **22**, a mount mat **24**, a cylindrical inner housing or can **26**, and heat insulating blanket or batt **28**, and a cylindrical outer housing or jacket **30**.

The core **22** may typically be a ceramic substrate having a monolithic structure with a catalyst coated thereon and will typically have an oval or circular cross section.

The mounting mat **24** is sandwiched between the core **22** and the can **26** to help protect the core **22** from shock and vibrational forces that can be transmitted from the can **26** to the core **22**. Typically the mounting mat **24** is made of a heat resistant and shock absorbing-type material, such as a mat of glass fibers or rock wool and is compressed between the can and the carrier in order to generate a desired holding force.

The heat insulating blanket **28** located inside the catalytic unit outer housing **30** may be made of a silica fiber insulation material having a weight percentage of SiO_2 of greater than 65%, and in preferred embodiments greater than 95%, and in highly preferred embodiments greater than 98%. Such material is known and commercially available, with one suitable example being supplied by BGF Industries, Inc. under the trade name SilcoSoft®, and another suitable example being supplied by ASGLAWO technofibre GmbH under the trade name Asglasil®. Such material is typically supplied in rolls, with the individual blankets **28** being die cut to the appropriate length and width for the corresponding device **18** after the material has been taken from the roll.

In accordance with the present invention, an external blanket **40** is wrapped around the unit outer housing **30** so as to substantially encapsulate the housing **30**.

In one embodiment, the external blanket **40** may be advantageously made of a silica fiber insulation material having a weight percentage of SiO_2 of greater than 65%, and in preferred embodiments greater than 95%, and in highly preferred embodiments greater than 98%. Such material is known and commercially available, with one suitable example being supplied by BGF Industries, Inc. under the trade name SilcoSoft®, and another suitable example being supplied by ASGLAWO technofibre GmbH under the trade name Asglasil®. Such material is typically supplied in rolls, with the individual blankets **40** being die cut to the appropriate length and width for the corresponding device **20** after the material has been taken from the roll. In one preferred form, the blanket **40** may have an average installed density of 0.18 grams/cubic centimeter to 0.30 grams/cubic centimeter of the silica fiber insulation material of the blanket **40**.

According to the invention, before the blanket **40** is installed into the device **18**, the blanket **28** is heat treated to achieve calcination of the silica fiber insulation material. In this regard, the blanket **40** is heated so that all of the silica fiber insulation material in the blanket **28** is raised to a temperature T greater than the maximum operating temperature T_{MAX} of the device **20**. This heat treatment improves the resiliency and erosion resistance of the silica fiber insulation material and also eliminates the potential for a "thermoset" failure mode that can result if the silica fiber material were calcinated in-situ in the device **20** during operation of the system. Preferably, this heat treatment takes place with the blanket **40** in an uncompressed or free state wherein there are no compressive forces being applied to the silica fiber insulation material of the blanket **40**. The temperature T preferably has some margin of safety above the maximum operating temperature T_{MAX} of the device **18**, with one preferred margin of safety being $1.05 \times T_{MAX}$.

This heat treatment improves the resiliency and erosion resistance of the silica fiber insulation material and also eliminates the potential for a "thermoset" failure mode that could result if the silica fiber material were to be calcinated in-situ on the device during operation of the system. Preferably, such heat treatment takes place with the external blanket **40** in an uncompressed or free state wherein there are no compressive forces being applied to the silica fiber insulation material of the external blanket **40**. The temperature T preferably has some margin of safety above the maximum operating temperature T_{MAX} of the device **18**, with one preferred margin of safety being $1.05 \times T_{MAX}$.

By heat treating the silica fiber heat insulation material to the temperature T greater than T_{MAX} before the external blanket **40** is installed on the device, the heat treated blanket can maintain suitable frictional engagement with the unit outer housing **30** over the desired life of the device because the silica fiber insulation material of the blanket **40** maintains its resiliency and does not take on a "thermoset" from the max operation temperature T_{MAX} of the device.

The heat treatment may advantageously be accomplished using an in-line oven wherein the silica fiber heat insulation material is unrolled from a supply roll of the material and passed flat through an oven on a conveyor so that the external blanket **40** is planar during the heat treatment to reduce or prevent differential heating of the material of the blanket **40** and variation in thickness of the material in the blanket **40**. After heat treatment, individual blankets **40** can be die cut to the desired length and width before installing on a device. Alternatively, however, a complete supply roll of the silica fiber heat insulation material can be heat treated, with or without rotation of the roll in an oven, whereby individual blankets **40** can be die cut to the desired length and width after heat treatment and before installing on the device. As yet an another alternative, the silica fiber insulation material can be die cut before heat treatment, with the blanket being slightly oversized in length and width to account for shrinkage during heat treatment, and with the die cut blankets then heat treated in an oven while laying flat on a planar surface.

In accordance with a second embodiment, the external blanket **40** may also advantageously be a high alumina blanket. In one embodiment, the external blanket **40** may be advantageously made of an alumina insulation material having a weight percentage of Al_2O_3 of greater than 65%, and in preferred embodiments greater than 95%, and in highly preferred embodiments greater than 98%. Such blankets are known and commercially available, with one suitable example being supplied by Saffil Ltd. of Cheshire, U.K. under the LDM trade name, and another suitable example being supplied by Mitsubishi under the MLS-2 trade name. In accordance with the present invention, these high alumina blankets **40** are also heat treated to achieve calcination prior to placement on the device **20**.

The calcined external blanket **40** of either embodiment is advantageously used as batting encapsulated in a covering **50** prior to placement on the device **20**, as illustrated in FIG. **2**. Calcination of the blanket **40** may be accomplished before encapsulating the blanket **40** in the covering **50**. However, calcination may also be accomplished in the covering **50** where the covering **50** will not be adversely impacted by the temperatures used in the calcinations. When installed on the device **20**, the side of the covering facing the heat side (e.g., the device **20**) may advantageously be foil, wire mesh or a high temperature textile, such as siliconized fiber glass or straight woven glass fiber.

It should be appreciated that devices in exhaust gas systems having external blankets according to the present invention substantially reduce damage and cracking when removing and replacing insulation, damage due to exposure to vibration, damage due to loose or otherwise inappropriate fit due to thermal set, and/or loss of insulation properties due to loose or otherwise inappropriate fit, and/or loss of insulation material.

It should also be appreciated that while the invention has been described herein in connection with a diesel combustion process in the form of, for example, a diesel compression engine, the invention may find use in devices that are utilized in exhaust gas systems for other types of combustion processes, including other types of internal combustion engines, including, for example, internal combustion engines that use gasoline or other alternative fuels.

The invention claimed is:

1. A method of providing external insulation for an exhaust gas aftertreatment or acoustic device having a maximum operating temperature T_{MAX}, the method comprising:

providing a blanket of silica fiber insulation material having a weight percentage of SiO_2 of greater than 65%;

calcining the blanket by heating all of the silica fiber insulation material to a temperature T greater than T_{MAX}, wherein T is less than a melting temperature of the silica fibers of the blanket;

securing the blanket around an outermost surface of the exhaust gas aftertreatment or acoustic device after the calcining step; and

encapsulating said blanket in a covering after the calcining step and prior to the securing step whereby said blanket is batting in said covering, wherein said covering between said blanket and said exhaust gas aftertreatment or acoustic device is a selected one of wire mesh or high temperature textile.

2. The method of claim **1** wherein T is at least $1.05\times T_{MAX}$.

3. The method of claim **1**, wherein said high temperature textile is a selected one of siliconized fiber glass or straight woven glass fiber.

4. The method of claim **1** wherein during the calcining step the blanket is in an uncompressed state.

5. The method of claim **1** wherein T_{MAX} is within the range of 300° C. to 1100° C.

6. A method of providing external insulation for an exhaust gas aftertreatment or acoustic device having a maximum operating temperature T_{MAX}, the method comprising:

providing a blanket of silica fiber insulation material having a weight percentage of SiO_2 of greater than 95%;

calcining the blanket by heating all of the silica fiber insulation material to a temperature T greater than T_{MAX}, wherein T is less than a melting temperature of the silica fibers of the blanket;

securing the blanket around an outermost surface of the exhaust gas aftertreatment or acoustic device after the calcining step; and

encapsulating said blanket in a covering after the calcining step and prior to the securing step whereby said blanket is batting in said covering, wherein said covering between said blanket and said exhaust gas aftertreatment or acoustic device is a selected one of wire mesh or high temperature textile.

7. A method of providing external insulation of ran exhaust gas after treatment or acoustic device having a maximum operating temperature T_{MAX}, the method comprising:

providing a blanket of silica fiber insulation material having a weight percentage of SiO_2 of greater than 65%;

calcining the blanket in an uncompressed state by heating all of the silica fiber insulation material to a temperature T greater than T_{MAX}, wherein T is less than a melting temperature of the silica fibers of the blanket and is at least $1.05\times T_{MAX}$ and T_{MAX} is within a range of 300° C. to 1100° C.;

encapsulating said blanket in a covering after the calcining step whereby said blanket is batting in said covering; and

securing the blanket around an outermost surface of the exhaust gas aftertreatment or acoustic device after the encapsulating step;

wherein said covering between said blanket and said exhaust gas aftertreatment or acoustic device is a selected one of wire mesh or high temperature textile.

8. The method of claim **7**, wherein said high temperature textile is a selected one of siliconized fiber glass or straight woven glass fiber.

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